

WHAT IS CLAIMED IS:

1. A system for switching and routing data associated with one or more subscribers within a subscriber community, comprising:

layer-2 switching functionality within a first network access switch, the layer-

5 2 switching functionality operable to:

receive data units communicated by one or more external devices using one or more external links;

receive data units communicated by layer-2 switching functionality of one or more other network access switches using one or more system links;  
10 and

switch the received data units for communication to an intermediate device within the first network access switch coupling the layer-2 switching functionality within the first network access switch to layer-3 routing functionality within the first network access switch; and

15 the intermediate device, operable to:

receive the switched data units from the layer-2 switching functionality;

selectively communicate to the layer-3 routing functionality one or more first data units that have been received by the layer-2 switching functionality on an external link and are to be subsequently switched for communication to layer-2 switching functionality of another network access switch on an associated system link, the first data units containing layer-3 routing information for a first data block comprising the first data units and a plurality of other data units, the first data units being communicated to the  
20 layer-3 routing functionality for processing including a determination of a system destination for the first data block that comprises an address of another network access switch that is associated with an external link coupled to the other network access switch;

selectively communicate to the layer-3 routing functionality one or  
30 more second data units that have been received by the layer-2 switching functionality on a system link and are to be subsequently switched for

communication to an external device on an associated external link, the second data units containing incoming system destination information specifying an address of the first network access switch that is associated with that external link, the incoming system destination information allowing a second data block comprising the second data units and a plurality of other data units to be switched and routed between two or more network access switches, the second data units being communicated to the layer-3 routing functionality for processing including formatting the second data units as standard layer-2 data units for switching and routing by external devices;

selectively store third data units, the third data units being data units within the first data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to determine a system destination for the first data block and before all other data units within the first data block ahead of the third data units have been switched for communication to the layer-2 switching functionality of the other network access switch; and

selectively store fourth data units, the fourth data units being data units within the second data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to format the second data units and before all other data units within the second data block ahead of the fourth data units have been switched for communication to the external device.

2. The system of Claim 1, wherein the intermediate device is further operable to selectively communicate fifth data units back to the layer-2 switching functionality without communicating the fifth data units to the layer-3 routing functionality, the fifth data units being data units received by the layer-2 switching functionality on a system link to be subsequently switched onto another system link.

3. The system of Claim 1, wherein the layer-3 routing functionality is operable to:

receive the first data units and the second data units from the intermediate device;

5 analyze the layer-3 routing information in the first data units to determine a system destination for the first data block, the system destination being an address of another network access switch that is associated with an external link coupled to the other network access switch;

10 communicate outgoing system destination information reflecting the system destination for the first data block to the intermediate device; and

modify the format the second data units containing the incoming system destination information as standard layer-2 data units for subsequent switching and routing by external devices.

15 4. The system of Claim 1, wherein the layer-3 routing information comprises an Internet Protocol (IP) address.

20 5. The system of Claim 1, wherein the plurality of network access switches are configured to appear to external device as a single network access switch.

25 6. The system of Claim 1, wherein the intermediate device is operable to store the third data units and the fourth data units in a particular order such that the layer-2 switching functionality can switch the third data units and the fourth data units contiguously, in order, and according to ATM conventions and Request for Comment (RFC) 1483.

7. The system of Claim 1, wherein the intermediate device is further operable to:

determine whether an external device coupled to the layer-2 switching functionality using an external link is ready to receive data units,

5 store the data units until the external device is ready to receive the data units; and

communicate the data units to the layer-2 switching functionality when the external device is ready to receive the data units so that the layer-2 switching functionality can subsequently switch the data units for communication to the external device on an associated external link at a rate that satisfies a traffic-shaping requirement for the external device.

8. The system of Claim 7, wherein the intermediate device is operable to store the data units by assigning the data units to a queue dedicated to a port of the first network access switch that is associated with the external link.

9. The system of Claim 7, wherein the rate changes dynamically in response to the external device retraining to a different speed.

20 10. The system of Claim 7, wherein:

a port of the first network access switch associated with an external link supports at least a first virtual circuit (VC) and a second VC, the first VC and the second VC being concentrated into a carrier VC and potentially having different traffic-shaping requirements; and

25 the layer-2 switching functionality is operable to switch sixth data units onto the carrier VC at a rate that satisfies the traffic-shaping requirement for the first VC and switch seventh data units onto the carrier VC at a rate that satisfies the traffic-shaping requirement for the second VC.

30 11. The system of Claim 7, wherein the intermediate device determines whether the external device is ready to receive the data units by communicating with the external device.

12. The system of Claim 11, wherein the intermediate device determines whether the external device is ready to receive the data units by performing a handshake with the external device.

- 5           13. The system of Claim 7, wherein the intermediate device determines whether the external device is ready to receive the data units by analyzing a clock signal to which the intermediate device and the external device are synchronized.

14. A system for switching and routing data associated with one or more subscribers within a subscriber community, comprising:

layer-2 switching functionality within a first network access switch, the layer-2 switching functionality operable to:

5 receive data units communicated by one or more external devices using one or more external links; and

switch the received data units for communication to an intermediate device within the first network access switch coupling the layer-2 switching functionality within the first network access switch to layer-3 routing functionality within the first network access switch;

10 the intermediate device, operable to:

receive the switched data units from the layer-2 switching functionality;

15 selectively communicate to the layer-3 routing functionality one or more first data units that have been received by the layer-2 switching functionality on an external link and are to be subsequently switched for communication to layer-2 switching functionality of another network access switch on an associated system link, the first data units containing layer-3 routing information for a data block comprising the first data units and a plurality of other data units, the first data units being communicated to the layer-3 routing functionality for processing including a determination of a system destination for the data block that comprises an address of another network access switch that is associated with an external link coupled to the other network access switch; and

20 selectively store second data units, the second data units being data units within the data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to determine a system destination for the data block and before all other data units within the data block ahead of the second data units have been switched for communication to  
25 the layer-2 switching functionality of the other network access switch.  
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15. A system for switching and routing data associated with one or more subscribers within a subscriber community, comprising:

layer-2 switching functionality within a first network access switch, the layer-2 switching functionality operable to:

5 receive data units communicated by layer-2 switching functionality of one or more other network access switches using one or more system links; and

switch the received data units for communication to an intermediate device within the first network access switch coupling the layer-2 switching functionality within the first network access switch to layer-3 routing functionality within the first network access switch;

10 the intermediate device, operable to:

receive the switched data units from the layer-2 switching functionality;

15 selectively communicate to the layer-3 routing functionality one or more first data units that have been received by the layer-2 switching functionality on a system link and are to be subsequently switched for communication to an external device on an associated external link, the first data units containing incoming system destination information specifying an address of the first network access switch that is associated with that external link, the incoming system destination information allowing a data block comprising the first data units and a plurality of other data units to be switched and routed between two or more network access switches, the first data units being communicated to the layer-3 routing functionality for processing including formatting the first data units as standard layer-2 data units for switching and routing by external devices; and

20 selectively store second data units, the second data units being data units within the data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to format the first data units and before all other data units within the data block ahead of the second data units have been switched for communication to the external device.

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16. A system for switching and routing data associated with one or more subscribers within a subscriber community, comprising:

first means within a first network access switch, for:

receiving data units communicated by one or more external devices  
5 using one or more external links;

receiving data units communicated by layer-2 switching functionality  
of one or more other network access switches using one or more system links;  
and

switching the received data units for communication to second means  
10 within the first network access switch coupling the first means within the first  
network access switch to third means within the first network access switch;  
the second means, for:

receiving the switched data units from the first means;

selectively communicating to the third means one or more first data  
15 units that have been received by the first means on an external link and are to  
be subsequently switched for communication to layer-2 switching  
functionality of another network access switch on an associated system link,  
the first data units containing layer-3 routing information for a first data block  
comprising the first data units and a plurality of other data units, the first data  
20 units being communicated to the third means for processing including a  
determination of a system destination for the first data block that comprises an  
address of another network access switch that is associated with an external  
link coupled to the other network access switch;

selectively communicating to the third means one or more second data  
25 units that have been received by the first means on a system link and are to be  
subsequently switched for communication to an external device on an  
associated external link, the second data units containing incoming system  
destination information specifying an address of the first network access  
switch that is associated with that external link, the incoming system  
30 destination information allowing a second data block comprising the second  
data units and a plurality of other data units to be switched and routed between



two or more network access switches, the second data units being communicated to the third means for processing including formatting the second data units as standard layer-2 data units for switching and routing by external devices;

5 selectively storing third data units, the third data units being data units within the first data block that have been communicated to the second means after the third means has begun to determine a system destination for the first data block and before all other data units within the first data block ahead of the third data units have been switched for communication to the layer-2  
10 switching functionality of the other network access switch; and

selectively storing fourth data units, the fourth data units being data units within the second data block that have been communicated to the second means after the third means has begun to format the second data units and before all other data units within the second data block ahead of the fourth  
15 data units have been switched for communication to the external device.

17. A method for switching and routing data associated with one or more subscribers within a subscriber community, comprising:

using layer-2 switching functionality within a first network access switch:

receiving data units communicated by one or more external devices  
5 using one or more external links;

receiving data units communicated by layer-2 switching functionality  
of one or more other network access switches using one or more system links;  
and

switching the received data units for communication to an intermediate  
10 device within the first network access switch coupling the layer-2 switching  
functionality within the first network access switch to layer-3 routing  
functionality within the first network access switch; and  
using the intermediate device:

receiving the switched data units from the layer-2 switching  
15 functionality;

selectively communicating to the layer-3 routing functionality one or  
more first data units that have been received by the layer-2 switching  
functionality on an external link and are to be subsequently switched for  
communication to layer-2 switching functionality of another network access  
20 switch on an associated system link, the first data units containing layer-3  
routing information for a first data block comprising the first data units and a  
plurality of other data units, the first data units being communicated to the  
layer-3 routing functionality for processing including a determination of a  
system destination for the first data block that comprises an address of another  
25 network access switch that is associated with an external link coupled to the  
other network access switch;

selectively communicating to the layer-3 routing functionality one or  
more second data units that have been received by the layer-2 switching  
functionality on a system link and are to be subsequently switched for  
communication to an external device on an associated external link, the second  
30 data units containing incoming system destination information specifying an

address of the first network access switch that is associated with that external link, the incoming system destination information allowing a second data block comprising the second data units and a plurality of other data units to be switched and routed between two or more network access switches, the second data units being communicated to the layer-3 routing functionality for processing including formatting the second data units as standard layer-2 data units for switching and routing by external devices;

selectively storing third data units, the third data units being data units within the first data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to determine a system destination for the first data block and before all other data units within the first data block ahead of the third data units have been switched for communication to the layer-2 switching functionality of the other network access switch; and

selectively storing fourth data units, the fourth data units being data units within the second data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to format the second data units and before all other data units within the second data block ahead of the fourth data units have been switched for communication to the external device.

18. The method of Claim 17, wherein using the intermediate device further comprises selectively communicating fifth data units back to the layer-2 switching functionality without communicating the fifth data units to the layer-3 routing functionality, the fifth data units being either data units received by the layer-2 switching functionality on an external link to be subsequently switched onto another external link or data units received by the layer-2 switching functionality on a system link to be subsequently switched onto another system link.

19. The method of Claim 17, further comprising, using the layer-3 routing functionality:

receiving the first data units and the second data units from the intermediate device;

5 analyzing the layer-3 routing information in the first data units to determine a system destination for the first data block, the system destination being an address of another network access switch that is associated with an external link coupled to the other network access switch;

10 communicating outgoing system destination information reflecting the system destination for the first data block to the intermediate device; and

formatting the second data units containing the incoming system destination information as standard layer-2 data units for subsequent switching and routing by external devices.

15 20 The method of Claim 17, wherein the layer-3 routing information comprises an Internet Protocol (IP) address.

21. The method of Claim 17, wherein the plurality of network access switches are configured to appear to external device as a single network access switch.  
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22. The method of Claim 17, wherein storing the third data units and the fourth data units comprises storing the third data units and the fourth data units in a particular order such that the layer-2 switching functionality can switch the third data units and the fourth data units contiguously, in order, and according to ATM conventions and Request for Comment (RFC) 1483.  
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23. The method of Claim 17, wherein using the intermediate device further comprises:

determining whether an external device coupled to the layer-2 switching functionality using an external link is ready to receive data units,

5 storing the data units until the external device is ready to receive the data units; and

communicating the data units to the layer-2 switching functionality when the external device is ready to receive the data units so that the layer-2 switching functionality can subsequently switch the data units for communication to the external  
10 device on an associated external link at a rate that satisfies a traffic-shaping requirement for the external device.

24. The method of Claim 23, wherein storing the data units comprises assigning the data units to a queue dedicated to a port of the first network access  
15 switch that is associated with the external link.

25. The method of Claim 23, wherein the rate changes dynamically in response to the external device retraining to a different speed.

20 26. The method of Claim 23, wherein:

a port of the first network access switch associated with an external link supports at least a first virtual circuit (VC) and a second VC, the first VC and the second VC being concentrated into a carrier VC and potentially having different traffic-shaping requirements; and

25 the layer-2 switching functionality is operable to switch sixth data units onto the carrier VC at a rate that satisfies the traffic-shaping requirement for the first VC and switch seventh data units onto the carrier VC at a rate that satisfies the traffic-shaping requirement for the second VC.

30 27. The method of Claim 23, wherein determining whether the external device is ready to receive the data units comprises communicating with the external device.

28. The method of Claim 27, wherein determining whether the external device is ready to receive the data units comprises performing a handshake with the external device.

5 29. The method of Claim 23, wherein determining whether the external device is ready to receive the data units comprises analyzing a clock signal to which the intermediate device and the external device are synchronized.

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30. A method for switching and routing data associated with one or more subscribers within a subscriber community, comprising:

using layer-2 switching functionality within a first network access switch:

receiving data units communicated by one or more external devices

5 using one or more external links; and

switching the received data units for communication to an intermediate device within the first network access switch coupling the layer-2 switching functionality within the first network access switch to layer-3 routing functionality within the first network access switch; and

10 using the intermediate device:

receiving the switched data units from the layer-2 switching functionality;

selectively communicating to the layer-3 routing functionality one or more first data units that have been received by the layer-2 switching functionality on an external link and are to be subsequently switched for communication to layer-2 switching functionality of another network access switch on an associated system link, the first data units containing layer-3 routing information for a data block comprising the first data units and a plurality of other data units, the first data units being communicated to the layer-3 routing functionality for processing including a determination of a system destination for the data block that comprises an address of another network access switch that is associated with an external link coupled to the other network access switch; and

selectively storing second data units, the second data units being data units within the data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to determine a system destination for the data block and before all other data units within the data block ahead of the second data units have been switched for communication to the layer-2 switching functionality of the other network access switch.

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31. A method for switching and routing data associated with one or more subscribers within a subscriber community, comprising:

using layer-2 switching functionality within a first network access switch:

receiving data units communicated by layer-2 switching functionality  
of one or more other network access switches using one or more system links;  
and

switching the received data units for communication to an intermediate device within the first network access switch coupling the layer-2 switching functionality within the first network access switch to layer-3 routing functionality within the first network access switch; and

using the intermediate device:

receiving the switched data units from the layer-2 switching functionality;

selectively communicating to the layer-3 routing functionality one or more first data units that have been received by the layer-2 switching functionality on a system link and are to be subsequently switched for communication to an external device on an associated external link, the first data units containing incoming system destination information specifying an address of the first network access switch that is associated with that external link, the incoming system destination information allowing a data block comprising the first data units and a plurality of other data units to be switched and routed between two or more network access switches, the first data units being communicated to the layer-3 routing functionality for processing including formatting the first data units as standard layer-2 data units for switching and routing by external devices; and

selectively storing second data units, the second data units being data units within the data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to format the first data units and before all other data units within the data block ahead of the second data units have been switched for communication to the external device.



32. Logic for switching and routing data associated with one or more subscribers within a subscriber community, the logic embodied in media and operable to:

use layer-2 switching functionality within a first network access switch to:

5           receive data units communicated by one or more external devices using one or more external links;

          receive data units communicated by layer-2 switching functionality of one or more other network access switches using one or more system links; and

10           switch the received data units for communication to an intermediate device within the first network access switch coupling the layer-2 switching functionality within the first network access switch to layer-3 routing functionality within the first network access switch; and  
use the intermediate device to:

15           receive the switched data units from the layer-2 switching functionality;

          selectively communicate to the layer-3 routing functionality one or more first data units that have been received by the layer-2 switching functionality on an external link and are to be subsequently switched for  
20           communication to layer-2 switching functionality of another network access switch on an associated system link, the first data units containing layer-3 routing information for a first data block comprising the first data units and a plurality of other data units, the first data units being communicated to the layer-3 routing functionality for processing including a determination of a  
25           system destination for the first data block that comprises an address of another network access switch that is associated with an external link coupled to the other network access switch;

          selectively communicate to the layer-3 routing functionality one or more second data units that have been received by the layer-2 switching  
30           functionality on a system link and are to be subsequently switched for communication to an external device on an associated external link, the second

data units containing incoming system destination information specifying an address of the first network access switch that is associated with that external link, the incoming system destination information allowing a second data block comprising the second data units and a plurality of other data units to be  
5 switched and routed between two or more network access switches, the second data units being communicated to the layer-3 routing functionality for processing including formatting the second data units as standard layer-2 data units for switching and routing by external devices;

selectively store third data units, the third data units being data units  
10 within the first data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to determine a system destination for the first data block and before all other data units within the first data block ahead of the third data units have been switched for communication to the layer-2 switching functionality of the other network  
15 access switch; and

selectively store fourth data units, the fourth data units being data units  
within the second data block that have been communicated to the intermediate device after the layer-3 routing functionality has begun to format the second data units and before all other data units within the second data block ahead of  
20 the fourth data units have been switched for communication to the external device.